CHAPTER 2. ANALYTICAL FRAMEWORK, COMMENTS FROM INTERESTED PARTIES, AND DOE RESPONSES

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CHAPTER 2. ANALYTICAL FRAMEWORK, COMMENTS FROM INTERESTED PARTIES, AND DOE RESPONSES

2.1 INTRODUCTION

2.1.1 Overview

The U.S. Department of Energy (DOE) is required to publish performance-based standards for walk-in coolers and walk-in freezers that achieve the maximum improvements in energy efficiency that are technologically feasible and economically justified. (42 U.S.C. 6313(f)(4)(A)) This chapter provides a description of the analytical framework that DOE is using to evaluate new energy conservation standards for walk-in coolers and freezers. The chapter sets forth the methodology, analytical tools, and relationships among the various analyses that are part of this rulemaking. The analyses performed as part of the accompanying notice and reported in this preliminary technical support document (TSD) are described in section ES.2 of the Executive Summary.

DOE proposed this analytical framework in the rulemaking framework document for walk-in coolers and freezers (December 22, 2008). DOE announced the availability of the framework document in a notice of public meeting and availability of a framework document published in the *Federal Register* on January 6, 2009. DOE presented the analytical approach to interested parties during a public meeting held on February 4, 2009. The framework document is available at www.eere.energy.gov/buildings/appliance_standards/commercial/pdfs/wicf_framework_doc.pdf.

Subsequent to the publication of the framework document and at the public meeting, DOE received numerous comments from interested parties regarding DOE's analytical approach. This chapter summarizes the key comments and describes DOE's responses. In this chapter, DOE also summarizes any significant changes that it has made to the analytical approach described in the framework document and that it has incorporated into its preliminary analyses. In the executive summary of the preliminary TSD, DOE identifies a number of issues for which DOE seeks public comment. DOE explains each of those issues in the relevant analysis sections below.

2.1.2 Miscellaneous Rulemaking Issues

2.1.2.1 Separate Standards

During the framework public meeting, several interested parties expressed concern about DOE's plan to create a single standard for an entire walk-in unit. SCE stated that it would be difficult for DOE to enforce requirements for the entire walk-in assembly, because some parts of the walk-in unit are sold separately. (SCE, Public Meeting Transcript, No. 15 at p. 27) Heating, Airconditioning, and Refrigeration Distributors International (HARDI) stated that DOE should not pursue a single whole-system standard because of the high level of variation among walk-in units. (HARDI, No. 28 at p. 2) Many stakeholders recommended that DOE should instead develop separate standards for the components of walk-in units. Southern California Edison (SCE), the Air-Conditioning, Heating, and Refrigeration Institute (AHRI), Chase, the Appliance Standards Awareness Project (ASAP), Craig, Earthjustice, and HARDI all commented that DOE should develop separate standards for the insulated envelope and for the refrigeration system. (SCE, Public Meeting Transcript, No. 15 at p. 27 and No. 32 at p. 8; AHRI, Public Meeting Transcript, No. 15 at p. 62; Chase, Public Meeting Transcript, No. 15 at p. 145; ASAP, No. 21 at p. 1; Craig, No. 22 at p. 2; Earthjustice, No. 24 at p. 2; HARDI, No. 28 at p. 2) Earthjustice stated its opinion that the statute requiring the rulemaking (42 U.S.C. 6313(f)(4)(A)) is phrased in the plural (*i.e.*, "standards") , indicating that DOE is authorized to publish more than one performance-based standard for walk-in units. (Earthjustice, Public Meeting Transcript, No. 15 at p. 54 and No. 24 at p. 2) ASAP stated its opinion that DOE could publish a performance standard with two components: a metric for the refrigeration system and a metric for the thermal integrity of the box. (ASAP, Public Meeting Transcript, No. 15 at p. 53) It was further suggested by Kason that if the system were divided into sub-systems, each bearing their own standards and performance ratings, then a large number of equipment classes may not be necessary. (Kason, No. 16 at p. 2)

After considering the issues raised by these comments, DOE intends to create one standard for the refrigeration systems of walk-ins and a separate standard for walk-in envelopes. Thus, two separate standards would apply to each walk-in unit: one for the refrigeration system and one for the envelope. The refrigeration system manufacturer would be responsible for complying with the standard applicable to that system and the envelope manufacturer would be responsible for complying with the standard for the envelope. DOE believes that well-defined, separate standards would capture the energy use of the equipment as a whole. DOE requests comment on this approach.

The American Council for an Energy Efficient Economy (ACEEE) suggested that DOE should adopt 2 metrics: a box metric expressed in kWh per square foot of surface area per year, and a refrigeration system metric with 3 values: capacity, steady state efficiency, and part load efficiency. (ACEEE, Public Meeting Transcript, No. 15 at p. 92) Kason stated that the walk-in enclosure can have a minimum BTU requirement listed to size the refrigeration system for the storage load, and that process or product cooling requiring additional refrigeration can be added to this. (Kason, No. 16 at p. 4) Alternatively, AHRI suggested that the refrigeration system should be required to meet a minimum energy efficiency standard expressed in terms of energy efficiency ratio (EER) or a similar metric. (AHRI, No. 33 at p. 3)

EPCA, as amended by the Energy Independence and Security Act of 2007 (EISA 2007), requires DOE to measure energy use in developing a test procedure for walk-ins. (42 U.S.C. 6314(a)(9)(B)(i)) Thus, DOE intends to set a standard for the refrigeration system based on the energy consumption as measured by the test procedure, rather than efficiency as suggested by AHRI. The test procedure would determine the energy consumption of a refrigeration system when it is paired with a theoretical, or nominal, envelope, measured in kWh/day or kWh/year. The proposed test procedure assumes a certain heat load of the theoretical envelope for sizing the refrigeration system, similar to Kason's suggested method. DOE intends to set a standard for the envelope in terms of energy consumption per square foot of surface area (kWh/ft^2), as recommended by ACEEE. Because the envelope consumes a minimal amount of energy, DOE intends to examine the impact of more efficient components (*e.g*., walls and doors). DOE's proposed test procedure pairs the envelope with a theoretical, or nominal, refrigeration system with a certain EER for analysis purposes. More efficient envelope components would result in less heat gain, which would be reflected as less energy consumed by the nominal refrigeration system. Cooler systems would use one EER and freezer systems would use a different EER. Thus, DOE would prescribe the same nominal EER for use with all cooler systems, and the same EER for use with all freezer systems, to compare the performance of walk-in envelopes across a range of sizes, product classes, and levels of feature implementation. DOE requests comment on this approach.

DOE has tentatively concluded that an analysis of sub-systems or components beyond the division of the envelope and refrigeration system is unwarranted. First, the envelope and refrigeration systems are discrete pieces of equipment for which energy use can be measured and standards set, and generally each has a single identifiable manufacturer. Although the envelope and refrigeration system may both incorporate separately-manufactured components (e.g. a compressor for the refrigeration system), these components may be understood to be purchased from a supplier. Second, to set standards for sub-systems or components of envelopes and refrigeration systems would require very complex analyses and a complex set of standards, and could have the effect of reducing the flexibility of manufacturers to develop innovative ways to comply with conservation standards for this equipment. DOE requests comment on this approach. For more information on how energy consumption was determined using the engineering analysis, see chapter 5 of the preliminary TSD.

2.1.2.2 Compliance and Enforcement

During the framework public meeting, the Air Conditioning Contractors of America (ACCA) asked how the standards would be enforced, and who would incur penalties for noncompliance: the facility owner or the installer. (ACCA, Public Meeting Transcript, No. 15 at p. 81) Hired Hand stated that its interpretation of the statute was that the end user is responsible to ensure that the equipment complies with the standard. (Hired Hand, Public Meeting Transcript, No. 15 at p. 68) SCE stated that for the California standards, enforcement is at the time that the walk-in is sold, when its information is entered into an appliance database. (SCE, Public Meeting Transcript, No. 15 at p. 127)

EPCA states that "the [energy conservation] standards shall apply to products…that are manufactured beginning on the date that is 3 years after the final rule is published." (42 U.S.C. 6313(f)(4)(B)(i) DOE energy conservation standards consistently govern products and equipment as manufactured at the point of manufacture. Therefore, DOE intends that the manufacturer would be responsible for complying with these standards, so the manufacturer, not the facility owner or end user, will incur any penalties related to noncompliance. Likewise, compliance would be determined at the point of manufacture, not the point of sale.

EPCA provides that "[t]he term 'manufacture' means to manufacture, produce, assemble or import." (42 U.S.C. 6291(10)) Therefore, anyone who manufactures, produces, assembles, or imports walk-ins could be considered the "manufacturer." Because of the various ways in which a walk-in could be manufactured, this could allow for more than one party being held responsible for complying with an energy conservation standard. Walk-ins consist of an envelope and a refrigeration system that are often made by different manufacturers. The refrigeration system may be installed in the envelope in a manufacturing plant, or the two components may be assembled on-site.

During the framework public meeting, many interested parties expressed concern about responsibility for compliance and whether the burden of compliance fell on the envelope and refrigeration manufacturers individually, the installer, or another party. Hired Hand stated that there is no single manufacturer because the equipment is customized, and rather than having a unitary design, walk-ins are more like houses in the way they are manufactured. (Hired Hand, Public Meeting Transcript, No. 15 at p. 89) ASAP agreed that the locus of responsibility for compliance could be in several places. (ASAP, Public Meeting Transcript, No. 15 at p. 70) Manitowoc stated that because walk-ins are mostly field-assembled, a performance standard might be impractical for assemblers to support if they were considered the manufacturers. (Manitowoc, Public Meeting Transcript, No. 15 at p. 32) Nor-Lake stated that for the walk-ins that they sell, the components are produced by multiple manufacturers, and only the panel specifications are in their control when they manufacture a product. (Nor-Lake, No. 30 at p. 1) Hired Hand stated that the walk-in may be manufactured by several parties and there is no ruling on who is responsible for the final layout of the walk-in. (Hired Hand, Public Meeting Transcript, No. 15 at p. 83)

Several stakeholders commented that the contractor who assembles the walk-in should be held responsible for the final walk-in product. Both Kason and Craig stated that often, the walk-in box manufacturer sells only the box to the customer, and a contractor installs the refrigeration system on-site. (Craig, Public Meeting Transcript, No. 15 at p. 78; Kason, Public Meeting Transcript, No. 15 at p. 88) Craig added that a contractor who installs a unit in the field should be considered the manufacturer, because if not, then walk-in manufacturers who supply units with and without the refrigeration system are not competitive with contractors in the market for fully-assembled walk-ins. (Craig, Public Meeting Transcript, No. 15 at p. 85; Craig, No. 22 at p. 6) EEI, ASAP, and Earthjustice agreed that contractors who assemble walk-ins on site should be responsible for ensuring that the walk-in complies with the standards. (EEI, Public Meeting Transcript, No. 15 at p. 88; ASAP, No. 21 at p. 1; Earthjustice, No. 24 at p. 3)

However, other interested parties disagreed. HARDI, a distributors' association, stated that the contractor does not control all of the variables in the walk-in and should not be responsible for the performance of the equipment, because they are only responsible for a portion of it. (HARDI, Public Meeting Transcript, No. 15 at p. 90) ACCA, a contractors' association, stated that it agreed with HARDI. (ACCA, Public Meeting Transcript, No. 15 at p. 90) ASAP stated that as an alternative to holding the contractor responsible, DOE could adopt standards that cover all new walk-in components and hold the original manufacturers of such components responsible for compliance. (ASAP, No. 21 at p. 1)

As discussed above, DOE intends to set separate standards for the envelope and refrigeration system of a walk-in. DOE understands that the two parts of a walk-in—the envelope and the refrigeration system—are typically manufactured by separate parties, and are often assembled by a third-party contractor who has no direct control over the performance of the individual components. Under this approach, the manufacturer of the envelope would be responsible for complying with the envelope standard, and the manufacturer of the refrigeration system would be responsible for complying with the refrigeration system standard. This approach provides strong incentives for both sets of manufacturers to create efficient components, and can be enforced because there are two readily-identifiable groups of manufacturers of these components who are directly responsible for the performance of each component. In cases where the same manufacturer produces both components, DOE still intends to treat the components separately in terms of compliance and enforcement, as this will ensure that both components meet the appropriate standard.

DOE intends to hold the manufacturer of the envelope responsible for complying with the envelope standard, and the manufacturer of the refrigeration system responsible for complying with the refrigeration system standard. DOE believes that this will address the concerns of Craig that manufacturers of envelopes who also supply refrigeration would not be competitive with contractors; under this approach, the manufacturer of the refrigeration system would be responsible for the performance, not the supplier. DOE believes that because of the structure of the walk-in market, it makes more sense to consider the envelope and refrigeration as separately manufactured components, rather than depart from its precedent and hold the installer or contractor responsible. Thus, DOE agrees with the approach suggested by ASAP, with the caveat that it does not intend to consider sub-systems or components beyond the division of the envelope and refrigeration system.

DOE found that for large walk-in envelopes, the manufacturer may ship the panels and other sub-assemblies (e.g. doors) disassembled, to be constructed on-site. The manufacturer provides instructions for assembling the walk-in, but the final layout is at the discretion of the contractor, installer, or even end-user. In this case, to maintain consistency, DOE intends to regulate the envelope as originally manufactured; i.e. at the manufacturer's factory, assuming that the manufacturer adequately conveys the intent of construction to the assembler.

2.1.2.3 Food Safety

Kason Industries stated that when setting standards, DOE should consider both storage and process applications and should not impose a standard that may compromise the ability of a walk-in cooler or freezer to maintain food safety in its intended application. (Kason, No. 16 at p. 1) Manitowoc stated that food safety must be factored into the analysis so that proper food storage temperatures are maintained under all conditions. (Manitowoc, No. 15 at p. 164) The Utilities Joint Comment recommended that DOE incorporate the thermal rating standard developed by NSF International to rate walk-in coolers and walk-in freezers (WICF). (Utilities Joint Comment, No. 32 at p. 8)

DOE recognizes that food refrigeration equipment (including walk-ins) must be tested for compliance with NSF regulations using the NSF International standard 7, which measures food temperature at a specific ambient condition for food safety purposes. DOE will not use NSF Standard 7 to rate equipment as recommended by the Utilities Joint Comment, because NSF Standard 7 does not test for an energy use metric. However, DOE does not intend to set an energy conservation standard that will conflict with the requirements of NSF Standard 7.

2.2 MARKET AND TECHNOLOGY ASSESSMENT

When DOE begins an energy conservation standards rulemaking, it develops information that provides an overall picture of the market for the equipment considered, including the nature of the equipment, market characteristics, and industry structure. This activity consists of both quantitative and qualitative efforts based primarily on publicly available information. The market assessment examined manufacturers, trade associations, and the quantities and types of equipment sold and offered for sale.

DOE reviewed relevant literature and interviewed manufacturers to develop an overall picture of the walk-in cooler and freezer industry in the United States. Industry publications and trade journals, government agencies, and trade organizations provided the bulk of the information, including (1) manufacturers and their market shares; (2) shipments by product type and capacity; (3) product information; and (4) industry trends.

Subsequent sections of this chapter describe the comments DOE received in response to its review of the walk-in cooler and freezer market for the framework document. The analysis developed as part of the market and technology assessment is described in chapter 3 of the preliminary TSD.

2.2.1 Equipment Classes and Scope of Coverage

When evaluating and establishing energy conservation standards, DOE generally divides covered equipment into equipment classes by the type of energy used, capacity, or other performance-related features that affect efficiency. Different energy conservation standards may apply to different equipment classes. (42 U.S.C. 6295(q))

Because DOE is considering separate standards for envelopes and refrigeration systems, DOE identified equipment classes separately for envelopes and refrigeration systems.

Table 2.2.1 Equipment Classes for Envelopes

Equipment Class	Description
Display Cooler	Cooler with display glass or glass doors for displaying merchandise
Display Freezer	Freezer with display glass or glass doors for displaying merchandise
Non-Display Cooler	Cooler without display glass or glass doors for displaying merchandise
Non-Display Freezer	Freezer without display glass or glass doors for displaying merchandise

Table 2.2.2 Equipment Classes for Refrigeration Systems

Equipment Class	Description
Dedicated condensing medium-temperature indoor system	Medium-temperature refrigeration system with a dedicated condensing unit located indoors
Dedicated condensing low-temperature indoor system	Low-temperature refrigeration system with a dedicated condensing unit located indoors
Dedicated condensing medium-temperature outdoor system	Medium-temperature refrigeration system with a dedicated condensing unit located outdoors
Dedicated condensing low-temperature outdoor system	Low-temperature refrigeration system with a dedicated condensing unit located outdoors
Multiplex condensing medium-temperature system	Unit cooler component of a medium-temperature multiplex refrigeration system
Multiplex condensing low-temperature system	Unit cooler component of a low-temperature multiplex refrigeration system

DOE received input from interested parties on the component definitions and equipment classes that DOE included in the framework document, as discussed below.

2.2.1.1 Equipment Classes – Envelope

SCE and EEI stated that the location of the walk-in, either indoors or outdoors, may necessitate separate equipment classes. (SCE, No. 32 at p. 7 and EEI, No. 25 at p. 3) SCE added that DOE should also evaluate partial indoor/outdoor boxes. (SCE, No. 32 at p.7) SCE added that interior space conditions including conditioned space, conditioned but within a hot kitchen or other similar environment, and unconditioned space should also be considered. (SCE, No. 32 at p.7)

For the envelope, DOE will not consider outdoor units as a separate equipment class because typical walk-in design does not include additional design features that impact energy consumption for outdoor units. They are typically modified only to endure weather conditions such as rain, snow, and ice. DOE seeks comment on this approach.

Craig stated that combination cooler-freezer units with a shared wall constitute a separate equipment class. (Craig, No. 15 at p. 117) ASAP and SCE stated that combination cooler-freezer units where the freezer is accessed through the cooler compartment should be considered a separate equipment class. (ASAP, No. 21 at p. 2 and SCE, No. 32 at p.7) ICS added that DOE should consider combination units of the same temperature as well. (ICS, No. 15 at p. 118)

Combination units are composed of two or more walk-in coolers or freezers sharing one or more walls, including walk-ins that share a wall but can be accessed independently, walk-ins that share a wall where one of the walk-ins can only be accessed through the other, and walk-ins within larger walk-ins. DOE requests feedback on this characterization. From an energy efficiency perspective, the shared wall of a combination unit tends to save energy by reducing steady-state infiltration across doorways and other barriers. DOE proposes that all combination units be classified according to the design of their individual units that compose the combined system, which would account for the steady-state infiltration benefit of the shared wall. For instance, if a combination cooler-freezer that was used for storage purposes utilizes no glass display doors, the cooler would be classified as a "Non-Display Cooler" and the freezer would be classified as a “Non-Display Freezer,” If each of the combination unit’s sub-parts complies with the standard, the combined system would also comply. DOE requests feedback on this proposed method of classification for combination units.

Interested parties discussed several issues related to doors. Eliason stated that a double-acting self-closing door is very common and should be considered when DOE classifies its equipment. (Eliason, No. 15 at p. 120 and No. 19 at p. 1) Eliason also recommended that all walk-in classes be considered with and without double-acting self-closing doors when DOE classifies its equipment. (Eliason, No. 15 at p. 120 and No. 19 at p. 1) Hired Hand commented that high traffic doors, specifically those used in supermarket storage applications, constitute a distinct application and equipment class. (Hired Hand, No. 27 at p. 2) ASAP and SCE stated that walk-ins with reach-in and/or glass doors should be a distinct equipment class. (ASAP, No. 21 at p. 2 and SCE, No. 15 at p. 116)

DOE has found that traffic considerations can be factored into the energy efficiency calculations used for specific walk-ins. DOE does not propose creating a distinct equipment class based on traffic conditions. Rather, technologies such as improved doors will be considered in the Market and Technology Assessment (Chapter 3 of the proposed TSD). However, DOE intends to consider walk-ins with glass doors as a separate equipment class because glass significantly affects the energy consumption of the walk-in. DOE requests feedback on this proposal.

Crown Tonka suggested that panel thickness constitutes different equipment classes since the R-value of a walk-in is directly related to the thickness of its panels. (Crown Tonka, No. 23 at p. 2) DOE proposes that panel thickness be addressed in the context of design options, which would recognize the insulation values associated with different insulation thicknesses. DOE requests feedback on this proposal.

Craig recommended that DOE consider separate classes for unassembled and preassembled boxes. (Craig, No. 22 at p. 1) DOE believes that assembly of the box (or envelope) does not constitute an equipment class, as it does not affect the energy consumption of the walk-in after it has been assembled.

2.2.1.2 Equipment Classes – Refrigeration

AHRI suggested that DOE consider separate refrigeration equipment classes for coolers and freezers. (AHRI, No. 15 at p. 116) AHRI also stated that blast freezers used to quickly freeze product should be separated from conventional walk-in freezers. (AHRI, No. 33 at p. 4) DOE proposes to consider low- and medium-temperature refrigeration systems as different classes, due to the inherent differences in the refrigeration equipment selected for these two different applications. However, blast freezers were not treated as a separate equipment class within this analysis because DOE believes that blast freezers would not significantly differ in performance from standard freezers when measured by the proposed test procedure. DOE requests comment on this assumption.

Craig Industries stated that many walk-in units are combinations, in which a cooler and freezer are packaged together and share a wall, but have separate refrigeration units either inside or outside of the building in which they are housed. (Craig, No. 15 at p. 117) Craig also stated that the only application where a combination unit would be served by the same refrigeration system providing two different temperature levels would be a rack system with several compressors, and that normal combination units share a common wall but have two different refrigeration systems. (Craig, No. 15 at p. 119) The Edison Electric Institute (EEI) stated that DOE should have different standards for combination units. (EEI, No. 25 at p. 3) In response to comments about combination units, DOE has tentatively decided that combination units sharing a wall but possessing separate, dedicated refrigeration systems will be analyzed as two separate units, each measured according to the standards for the appropriate product class for the unit. DOE does not propose to create a separate class for refrigeration systems of combination units, because these systems would not be significantly different from refrigeration systems of individual coolers and freezers. For combination units connected to rack, or multiplex, compressors, each envelope would have its own unit cooler, and each would be analyzed separately as a unit cooler connected to a multiplex condensing system. DOE requests comment on this approach.

Kason stated that, due to the disparity in condensing unit operating temperatures present, a division between indoor and outdoor units would be warranted. (Kason, No. 16 at p. 2) EEI agreed that separate efficiency standards for indoor and outdoor units were necessary. (EEI, No. 25 at p. 3) The Utilities Joint Comment was in agreement with other parties in that indoor and outdoor self-contained envelopes should be separate classes, and suggested that partially-indoor envelopes and freezers located within coolers necessitated their own classes. It also stated that a distinction should be made within indoor units between envelopes in conditioned spaces, envelopes located in hot kitchens, and envelopes in unconditioned spaces. (Utilities Joint Comment, No. 32 at p. 7) DOE agrees that indoor and outdoor units should be grouped into different equipment classes. In this differentiation, the condensing unit of the refrigeration system is determined to be either inside or outside, as the location of the condensing unit is a determining factor of the efficiency of the system. The proposed test procedure allows for two sets of test conditions, corresponding to indoor and outdoor condensing units. DOE recognizes that there could be other operating conditions, such as freezers within coolers, and walk-ins located in either conditioned spaces or hot kitchens. However, DOE believes that the test conditions outlined in the proposed test procedure will capture the majority of walk-in applications.

Manitowoc stated that a separate class could consist of an indoor box with a dedicated outdoor condensing unit, and that remote condensing units could include both the aforementioned systems and systems connected to a remote rack condensing unit serving multiple envelopes. (Manitowoc, No. 15 at p. 117) The Utilities Joint Comment, however, stated that DOE should evaluate self-contained, dedicated remote, and rack condensing units as separate equipment classes. (Utilities Joint Comment, No. 32 at p. 7) Chase stated that the most commonly used system in supermarkets consists of a single rack system with the same flow of refrigerant serving the cooler, freezer, and display cases. (Chase, No. 15 at p. 120) DOE is proposes to analyze rack, or multiplex, units separately. In these analyses, the unit cooler is evaluated by itself, and the multiplex compressor/condensing unit is not considered in the analysis. However, DOE proposes to group self-contained and split system refrigeration systems into the same class, called “dedicated condensing,” because each system has one condensing unit that is dedicated to it. DOE believes that these systems are sufficiently similar and will obtain similar results using the test procedure; therefore, creating separate classes is not necessary. DOE requests comment on this approach.

2.2.1.3 Classifying Envelopes by Size

During the framework public meeting, interested parties discussed sizes of walk-ins as this metric relates to characterization and classification of the equipment. DOE proposed classifying walk-ins as follows: (1) small: ≤ 1,000 square feet of floor area; (2) medium: 1,000 ≤ X ≤ 2,000 square feet; (3) large: ≥ 2,000 square feet. HARDI stated that DOE's proposed classification of small was not small enough, and commented that most walk-ins supplied by their members were about 200 square feet of floor area. (HARDI, No. 15 at p. 115) ICS stated that 200 to 400 square feet would be typical for small walk-ins. (ICS, No. 15 at p. 152) Manitowoc commented that small should be about 100 square feet. (Manitowoc, No. 15 at p. 151) HARDI argued that walk-ins of less than 500 square feet have design characteristics that differ significantly from units of 1,000 square feet and larger. (HARDI, No. 28 at p. 2) AHRI suggested that capacity ranges should be expressed in volume rather than area. (AHRI, No. 33 at p. 4) AHRI recommended the following classes: (1) small: 2,000 cubic feet (250 square feet at 8 foot ceilings), which is typical of restaurants; (2) medium: 10,000 cubic feet (1,250 square feet at 8 foot ceilings), which is typical of convenience and grocery stores; (3) large: > 10,000 cubic feet for larger units. (AHRI, No. 33 at p. 4) Nor-Lake stated that they can build ceilings of up to 24 feet high for large warehouse units and other manufacturers are capable of ceilings of 30 feet or higher, which indicates that volume could play a role in energy efficiency. (Nor-Lake, No. 30 at p. 1)

Among interested parties, volume was the preferred option for characterizing walk-ins. Stakeholders unanimously agreed that volume would be preferable to floor area as a method of characterizing walk-ins. (Manitowoc, No. 15 at p. 56; EEI, No. 15 at p. 105; ASAP, No. 15 at p.115; EEI, No. 15 at p. 116; AHRI, No. 15 at p. 116; ICS, No. 15 at p. 152; Crown Tonka, No. 23 at p. 1; ASAP, No. 21 at p. 2; EEI, No. 25 at p. 3; Northwest Energy Efficiency Alliance (NEEA), No. 18 at p. 3; SCE, No. 32 at p. 7) Manitowoc stated that using floor area is impractical because walk-ins can vary significantly by ceiling height. (Manitowoc, No. 15 at p. 56) ASAP stated that test metrics should account for combined interior surface area of walls, ceilings, and floors, the volume of the conditioned space, or both. (ASAP, No. 21 at p. 2) ASAP stated that the three size categories based on floor area increments of 1,000 square feet are not useful and commented that the break points appear to be arbitrary. (ASAP, No. 21 at p. 2) Crown Tonka recommended that the test metric be kWh per cubic foot. (Crown Tonka, No. 23 at p. 1)

DOE recognizes that the size classifications originally proposed in the framework document did not reflect typical sizes of walk-ins. DOE has found that walk-ins are highly customizable, particularly with regard to size, and that it can characterize the relationship between size and energy consumption within a given equipment class. As such, assigning size classifications would be arbitrary. DOE proposes no specific size classifications to further distinguish its envelope equipment classes since the use of arbitrary size could distort the standard that is created based on the engineering analysis. DOE may select a number of "sizes" purely for the purposes of generating cost-efficiency curves in the engineering analysis. DOE requests stakeholder feedback on this proposal.

2.2.1.4 Scope

Regarding the scope of the equipment covered by the rulemaking, HARDI inquired as to whether the new standards will apply to reach-in blowers, and then suggested that DOE not evaluate equipment with a rating greater than 5 horsepower. (HARDI, No. 28 at p. 3)

Any equipment that fits the definition of a "walk-in" as specified in EPCA is within the scope of this rulemaking. Reach-ins are excluded because the term "reach-in" refers to equipment that is accessed by reaching into it instead of walking into it; because it cannot be walked into, it does not meet the definition of "walk-in." However, DOE cannot exclude refrigeration equipment based on horsepower.

2.2.2 Technology Assessment

As part of the market and technology assessment, DOE developed a list of technologies to consider for improving the efficiency of walk-in coolers and freezers. Chapter 3 of the preliminary TSD includes the detailed list of all technology options DOE identified for further consideration in this rulemaking.

2.2.2.1 Envelope Design Option Considerations

Eliason stated that double-acting self-closing doors are considered a proprietary and not yet commercially available technology, but DOE should consider them as a design option in the analysis. (Eliason, No. 19 at p. 3) AHRI suggested that no proprietary technologies should be considered in this rulemaking. (AHRI, No. at p. 5)

DOE found that there are dozens of commercial available doors with various design characteristics that reduce air exchange both when open and when fully closed. Because DOE could not consider each individual door independently and because the actual door energy performance is highly dependent on human behavior, DOE did not consider any unique designs. Instead, as prescribed in the proposed WICF test procedure, DOE utilized specific assumptions about door opening frequency and duration for three major types: passage, glass display, and freight doors. As described in the test procedure, manufacturers receive credit for use of automatic opening/closing controls that reduce the door opening duration. Therefore, the automatic opening/closing control was considered a design option.

EPCA specified that a primary door must meet minimum R-value insulation requirements to reduce heat conduction. (42 U.S.C. 6313(f)(1)(C)) However, doors that do not meet EPCA insulation R-value prescriptive requirements may be considered air infiltration reduction devices if installed as "secondary" doors. The performance of these secondary devices is measured by a device effectiveness test described in WICF test procedure. For design options, DOE considered infiltration reduction devices with varying levels of effectiveness.

2.3 SCREENING ANALYSIS

The purpose of the screening analysis is to evaluate the technologies identified in the technology assessment to determine which options to consider further. First, DOE removed from consideration those technology options whose energy consumption could not be adequately measured by the DOE test procedure. DOE also removed technologies that do not change or affect the energy efficiency metrics of walk-in coolers and freezers. Second, the screening analysis examines whether the remaining technologies (1) are technologically feasible; (2) are practicable to manufacture, install, and service; (3) have an adverse impact on product utility or availability; and (4) have adverse impacts on health and safety. DOE reviewed the list of walk-in cooler and freezer technologies according to these criteria in consultation with industry, technical experts, and other interested parties. In the engineering analysis, DOE further considers the energy-saving technologies that it did not eliminate in the screening analysis. Chapter 4 of the preliminary TSD, the screening analysis, contains details about DOE's screening criteria.

2.3.1 Screened-out Technologies: Refrigeration System

DOE received a number of comments regarding technologies that could be considered in the analysis for this rulemaking. Kason suggested that hot gas defrost, a possible technology option, may have a negative impact on energy efficiency due to the fact that the evaporator fan continues to run during defrost, resulting in the walk-in filling with warm air (Kason, No. 15 at p. 87). SCE inquired as to why electronically commutated motors (ECMs), also known as brushless DC motors, were included as a technology option in light of the fact that they are required by EISA 2007 and mandated in California. (SCE, No. 15 at p. 124) SCE further expressed that ECMs should not be a screening option, with the possible exception of the 460-Volt option. (SCE, No. 15 at p. 139) Manitowoc stated that floating head pressure and external heat rejection will not provide a benefit for condensing units located indoors in constant-temperature conditions. (Manitowoc, No. 15 at p. 137) AHRI stated that economizer cooling is inapplicable to this product and should be removed as a technology option. (AHRI, No. 14 at p. 140) AHRI also stated that expansion valves, including thermostatic expansion valves (TXVs), electronic expansion valves (EEVs), and differential pressure TXVs (DPTXVs), should not be included in the analysis, as they offer no real efficiency benefits. (AHRI, No. 33 at p. 5)

A number of these technologies presented for consideration were not included in the analysis for various reasons. Hot gas defrost was not considered due to the fact that a number of manufacturers were in agreement that the feature is not likely to result in a net energy savings, as compressor and fan operation are required during the defrost period. ECMs are only considered as a design option for condenser fans because they are already mandated for all evaporator fans by EISA 2007. Economizer cooling involves directing outside air into the interior of a conditioned structure during lower-temperature hours. This would generally be inapplicable to walk-ins because the outside air would rarely, if ever, be at a lower temperature than the refrigerated air inside the walk-in; therefore, DOE removed economizer cooling from consideration as a technology option. DOE determined that floating head pressure provides no measurable benefit for indoor units, as indoor units are tested at only one ambient condition according to the proposed test procedure. DOE considered this option only for units located outdoors and subject to substantial ambient temperature variations. DOE did not consider advanced valves such as EEVs as design options by themselves, as, in most cases, they are included as part of other technology options, such as floating head pressure controls.

2.3.2 Screened-out Technologies: Envelope

EEI believes that using alternative primary thermal energy sources for the purposes of anti-sweat heating should not be considered as an energy efficiency design option. (EEI, No. 25 at p. 4) DOE agrees that alternative thermal energy sources should not be considered, as DOE did not find any commercially available alternatives.

2.4 ENGINEERING ANALYSIS

The engineering analysis (chapter 5 of the preliminary TSD) establishes the relationship between the manufacturing production cost and the efficiency for each walk-in cooler or freezer. This relationship serves as the basis for cost-benefit calculations in terms of individual customers, manufacturers, and the nation. Chapter 5 discusses the equipment classes analyzed, representative baseline units, incremental efficiency levels, methodology used to develop manufacturing production costs, cost-efficiency curves, impact of efficiency improvements on the equipment, and methodology used to extend the analysis to low-shipment-volume equipment classes.

In the engineering analysis, DOE evaluates a range of equipment efficiency levels and associated manufacturing costs. The purpose of the analysis is to estimate the incremental MSPs that would result from increasing efficiency levels above the baseline model in each equipment class. The engineering analysis considers technologies not eliminated in the screening analysis. The LCC analysis uses the cost-efficiency relationships developed in the engineering analysis.

DOE typically structures its engineering analysis around one of three methodologies: (1) the design-option approach, which calculates the incremental costs of adding specific design options to a baseline model; (2) the efficiency-level approach, which calculates the relative costs of achieving increases in energy efficiency levels without regard to design options used to achieve such increases; and/or (3) the reverse-engineering or cost-assessment approach, which involves a “bottom-up” manufacturing cost assessment based on a detailed bill of materials derived from tear-downs of the equipment being analyzed.

In the framework document, DOE stated its intention to use a design-option approach for the engineering analysis. In a design-option approach, analysis is performed in terms of incremental increases in efficiency due to the implementation of selected design options. For each equipment class, the engineering analysis estimates manufacturer production costs (MPCs) for each successive design option. Hence, in the framework document, DOE requested industry cost data and shipment data.

2.4.1 Analysis Approach

AHRI stated that the use of an efficiency-level approach to determine the relationship between manufacturer production cost and energy efficiency levels has shown its limit during past rulemakings. (AHRI, No. 33 at p. 5) The Joint Comment stated that DOE should use a design-option approach, and to ensure transparency, the most significant design options should be separately evaluated, rather than aggregated with other measures. (Joint Comment, No. 21 at p. 3) HARDI and Eliason also recommended that DOE should use a design-option approach. (HARDI, No. 28 at p. 2; Eliason, No. 19 at p. 3)

For the preliminary analyses, DOE used a design-option approach for determining the cost-efficiency relationship. A design-option approach uses individual design options, or combinations of design options, to identify increases in efficiency. Under this approach, DOE bases its estimates of equipment cost and energy consumption on manufacturer or component supplier data or engineering computer simulation models. Individual design options, or combinations of design options, are added to the baseline model in ascending order of cost-effectiveness. This approach involved consultation with outside experts, review of publicly available cost and performance information, and modeling of equipment cost and energy consumption. See chapter 5 of the preliminary TSD for more information about the engineering analysis approach.

2.4.2 Definition of Baseline Equipment

DOE received numerous comments during the framework public meeting and comment period regarding the definition of baseline units for the purpose of this analysis. In the framework document, DOE presented two options for defining the baseline unit and its efficiency level: that of using walk-in models compliant with EPCA as modified by EISA 2007, and that of using baseline models determined based on the units present in the market prior to the date EPCA's prescriptive standards became applicable to walk-in equipment and then present in the installed base. In that document, DOE requested comment from interested parties on these options, and on whether other approaches existed for defining the baseline efficiency level for walk-in equipment.

At the public meeting, ASAP commented that DOE should use the existing prescriptive standards within EISA 2007 and assemble a baseline unit in accordance with those requirements. (ASAP, Public Meeting Transcript, No. 15 at p. 122) ASAP further stated that the law prohibits the Secretary from setting a standard less stringent than that already in place (*i.e.*,EISA 2007), and thus that DOE must establish the efficacy of current standards in order to evaluate incremental energy savings without simply remaking the existing prescriptive standard. (ASAP, No. 15 at p. 123, No. 15 at p. 130) NEEA also stated that the baseline efficiency level should be no lower than the standards already in effect. (NEEA, No. 18 at p. 3) SCE concurred, agreeing in the public meeting and by written comment that the baseline should be the current legal requirement set forth in EISA 2007. (SCE, No. 15 at p. 131, No. 32 at p. 8) Craig disagreed, stating that overall product life cycle should be taken into account, as performance changes in real-world environments, and thus the baseline should be determined by studying existing units. (Craig, No. 15 at p. 127) EEI proposed that perhaps a comparison between current models and

2007 (pre-EISA 2007) models should be made in order to determine the impact of EISA 2007 on the technology thus far, and also suggested that DOE determine the impact of EISA 2007 by studying the increase in production of energy-efficient units as compared to the period before the passage of EISA 2007. (EEI, No. 15 at p. 122 and No. 25 at p. 3)

A number of comments were made by interested parties addressing the short duration for which EISA 2007 has been in effect and the precedent set by the existing California standards that preceded EISA 2007. SCE stated that due to the similarity between the requirements of EISA 2007 and those of the California standards, 10 percent of the U.S. population has been effectively using those standards for several years. (SCE, No. 15 at p. 124) PG&E agreed that the EISA 2007 standard was based upon the California requirements. (PG&E, No. 15 at p. 126) Earthjustice stated that California and EISA 2007 standards should not have a diminished role just because they are new. (Earthjustice, No. 15 at p. 132) However, AHRI added that the lack of enforcement of the California standards means that they may not comprise a true baseline and that, because the EISA 2007 legislation is still quite new, and instead, DOE should use equipment that has been available for five years because it would better represent the installed base. (AHRI, No. 15 at p. 122; No. 15 at p. 129)

Because EPCA's prescriptive standards are currently in effect and mandatory, this rulemaking must assume that a baseline model complies with these standards as suggested by ASAP, NEEA, and SCE. Furthermore, EPCA states that performance-based standards must achieve the maximum <u>improvement</u> in energy that the Secretary determines is technologically feasible and economically justified. (42 U.S.C. 6313(f)(4)(A) [Emphasis added] DOE interprets this to mean, as it has uniformly done in similar contexts in this program (i.e., in interpreting 42 USC 6295(o)(2)(a)), that the improvement must be measured with reference to products and equipment that meet existing standards that apply to them. Thus, any possible standard must achieve an improvement in energy efficiency over the existing standards, and DOE cannot accept the suggestion of Craig and AHRI that it define baseline walk-in equipment by reference to installed equipment that does not meet EPCA's current, prescriptive standards. A comparison of pre- and post-EISA 2007 models, as suggested by EEI, would be outside the scope of this rulemaking.

DOE also received comments during the public meeting and comment period suggesting other factors aside from compliance with EISA 2007 that could be taken into account when defining the baseline. Crown Tonka stated that baseline units should be of a simple configuration with normalizing factors for configuration changes, with those factors being developed by the responsible manufacturer. (Crown Tonka, No. 23 at p. 2) Craig stated that the most popular walk-in cooler in the U.S. is an 8×10×7.5 ft single-door model and that the most popular freezer is a 6×8×7.5 ft single-door model, and suggested that these sizes be taken into consideration as the baseline. (Craig, No. 22 at p. 6)

In keeping with the overall approach of separate standards for the two components of a walk-in, DOE considered two sets of baseline specifications, one for the envelope and the other for the refrigeration system. These two categories were further subdivided by equipment class designations (cooler or freezer, storage or display, etc.), as well as representative unit sizes determined in accordance with the distribution of capacities of most commonly sold models. In determining the specifications of these baseline units, including component specifications, dimensional values, and other technical data, DOE surveyed a selection of units and models currently available in the marketplace which meet the baseline levels of performance; that is, EISA 2007-compliant levels of performance for the baseline. For a more detailed explanation of the formulation of baseline unit specifications, as well as data regarding the specifications used, please see chapter 5.

2.4.3 Materials Price Trends

In regards to price trends over time, AHRI suggested that DOE perform a realistic analysis based on recent materials price trends in order to assess current and future equipment prices. (AHRI, No. 33 at p. 3)

DOE determined the cost of raw materials by using prices for copper, steel, and aluminum from the American Metals Market. Prices for rifled and unrifled copper tubing were obtained directly from a tubing manufacturer. Because metal prices have fluctuated drastically over the last few years, DOE used metal prices that reflect a five-year average of the Bureau of Labor Statistics Producer Price Indices (PPIs) from 2004 to 2009 with an adjustment to 2009$. DOE used the PPIs for copper rolling, drawing, and extruding, and steel mill products, and DOE made the adjustments to 2009$ using the gross domestic product implicit price deflator.

2.4.4 Refrigerants

DOE received several comments regarding the choice of refrigerants to be used in its analysis. HARDI stated that the industry is in the midst of a refrigerant transition, and that DOE should consider only equipment using hydrofluorocarbon (HFC) refrigerants and associated performance metrics in its analysis. (HARDI, No. 15 at p. 141) ICS further expressed that the use of hydrochlorofluorocarbons (HCFCs) in the analysis would not be logical, as these refrigerants would be phased out by 2010. (ICS, No. 15 at p. 166) Manitowoc and AHRI additionally agreed that the use of HFC refrigerants as the basis for analysis would be appropriate. (Manitowoc, No. 15 at p. 166 and AHRI, No. 15 at p. 167) In further comments, AHRI also stated that the majority of the walk-in industry has already transitioned to the use of HFC refrigerants and foam blowing agents, and that DOE should thus base all of its analyses, including cost-efficiency curves, “max tech,” and manufacturer equipment prices, on the use of HFC-based equipment. (AHRI, No. 33 at p. 5)

Due to the phaseout of HCFC refrigerants in this industry, HFC refrigerants are most likely to be used in this equipment in the future. DOE has assumed that only HFC refrigerants will be utilized by WICF refrigeration systems and has based its analysis solely upon equipment containing those refrigerants. Other alternative refrigerants, such as ammonia, hydrocarbons, and CO_2, were not considered in this analysis, as they are not currently used in domestically manufactured WICF refrigeration systems. Additionally, some of these refrigerants, including ammonia, could be limited by State and local building codes due to toxicity concerns. As a result, DOE has chosen HFC refrigerants as the basis for its analysis going forward.

2.4.5 Shipping Cost

Craig expressed that the shipping cost was normally 4-6 percent of equipment cost and could increase substantially with increase in wall thickness, due to the commonly used “cube rule” for freight shipments and that thicker insulation could result in higher fuel consumption for shipping that would be counter to the intent of the standard. (Craig, No. 22 at p. 7)

DOE believes that steps can be taken to avoid “cube rule” cost mark-ups by appropriate planning and freight company selection. In addition, many walk-in manufacturers ship units with 6” thick walls. The effect of thickness, *i.e.* increased shipped volume per completed walk-in, is the same problem that manufacturers see when manufacturing various sizes of walk-in envelopes. Therefore, since manufactures regularly avoid “cube rule” markups, the freight shipping cost should increase linearly with increase in the volume of the product shipped. DOE requests cost data on shipping cost of combinations of equipment wall thickness and gross area of panels. DOE believes that the increase in fuel consumption for shipping versus the energy savings seen from increased wall thickness caused by thicker insulation is minimal. The life cycle energy savings of a walk-in with thicker walls would exceed the energy used for shipping by an order of magnitude.

2.5 MARKUPS TO DETERMINE EQUIPMENT PRICE

DOE used manufacturer-to-customer markups to convert the MSPs estimated in the engineering analysis to customer prices, which then were used in the LCC, PBP, and manufacturer impact analyses. DOE calculates markups for baseline equipment (baseline markups) based on the markups at each step in each distribution channel to obtain the customer purchase price for the baseline equipment sold through each channel. DOE similarly calculates incremental markups that relate the change in the manufacturer sales price of higher-efficiency models (the incremental cost increase) to the change in the customer sales price.

To develop markups, DOE must identify how the equipment is distributed from the manufacturer to the customer (the distribution channels). After establishing appropriate distribution channels for each equipment class, DOE used economic data from the U.S. Census Bureau, HARDI, ACCA, and other sources to define how prices are marked up as the equipment pass from manufacturers to customers.

2.5.1 Distribution Channel Structure

At the framework public meeting, DOE proposed three distribution channels similar to those used for the commercial refrigeration equipment (CRE) standards rulemaking analysis. During the discussion of the three distribution channels for WICF, Craig Industries commented about the second distribution channel as proposed by DOE: Manufacturer -> Distributor -> Customer. Craig Industries said that DOE should instead use the following distribution channel: Manufacturer -> Mechanical Contractor -> Customer. (Craig, No. 15 at p. 169) HARDI agreed with Craig on this comment. (HARDI, No. 15 at p. 171)

Based on the comments above, DOE will use the second distribution channel as proposed above by Craig in its rulemaking analysis.

In another related comment, Craig Industries proposed a new distribution channel to reflect the distribution of WICF equipment from a foodservice dealer directly to the customer as shown here: Foodservice Dealer -> Customer. (Craig, No. 22 at p. 6) HARDI, on the other hand, suggested a modified distribution channel as follows: Manufacturer -> Dealer -> Customer. (HARDI, No. 28 at p. 2)

Based on these comments about an additional distribution channel, DOE will re-examine the WICF market and consider this alternative distribution channel in addition to the three channels already proposed.

2.5.2 Data Sources for Distribution Channel Markups

On the topic of data sources request from DOE for calculating the distribution channel markups, HARDI suggested that the first distribution channel is appropriate for almost all retrofit and repair of WICF equipment, and may account for 10-20 percent of new installations. Whereas the distribution channel #3 as proposed by DOE would be predominantly for new WICF equipment. (HARDI, No. 15 at p. 171) Eliason also provided a sample distribution dataset. (Eliason, No. 19 on 7-1 at p.1)

DOE appreciates the information and dataset provided above and will incorporate this information in its analysis.

2.5.3 Markups/Price Determination

On the topic of markups and the customer price determination of the WICF equipment, AHRI and HARDI informed DOE about the difficulty of performing a markups analysis on a complex market such as walk-in coolers and freezers. (AHRI, No. 15 at p. 173; HARDI, No. 28 at p. 2; HARDI, No. 28 at p. 5; HARDI, No. 15 at p. 176) HARDI further advised DOE to consider more than one distribution channel. (HARDI, No. 15 at p. 177)

DOE intends to model the WICF market and the markups analysis using multiple distribution channels (as described above) and will conduct its markups analysis with all due caution. DOE will also invite further comments on the details of the markup analysis when it is presented as part of the preliminary analysis.

2.6 ENERGY USE CHARACTERIZATION

The energy use characterization assesses the energy savings impacts from higher efficiency levels and provides the basis for the energy savings used in the LCC and subsequent analyses. The energy use characterization used the individual energy estimates from the engineering analysis for different classes of envelopes and the refrigeration systems to assess the aggregate energy savings for many possible combinations of matched sets of envelope and refrigeration system of higher efficiencies. DOE assessed the energy savings impacts for two different classes of cooler envelopes and two different classes of freezer envelopes matched with a single class of multiplex condensing refrigeration systems and two classes of dedicated condensing refrigeration systems (one each with indoor and outdoor condenser locations). For the dedicated condensing systems with outdoor condensers, the energy savings were also analyzed across a range of U.S. climates. For the multiplex condensing systems *i.e.*, systems connected to compressor racks, DOE did not consider the impact of variability of climate. Although the condensers for these systems are also located outside, the compressor racks serve additional loads at the same time, which also impact their performance. For the analysis of energy use of envelopes with unit coolers served by multiplex condensing equipment, where the compressor rack efficiency is not the subject of this rulemaking, DOE used the annual condensing unit performance, or EER, estimates for coolers and freezers, as provided for by the proposed test procedure. Various design options corresponded to different energy efficiency levels for the envelopes and the refrigeration systems. DOE assessed the energy impacts at the level of the envelope and the associated refrigeration system. DOE's analysis did not include potential additional energy impacts at the whole building level, as these impacts will be small and uncertain in most instances. As part of the energy use characterization, DOE made certain assumptions regarding system configuration, and usage, including how the equipment is operated and under what conditions and has documented these assumptions in the energy analysis. Chapter 7 of the preliminary TSD provides a detailed description of the energy analysis methodology.

DOE received the following comments in response to a proposed energy use characterization for walk-in coolers and freezers outlined in the framework document. Manitowoc commented that the use of whole building simulation to establish whole building energy impacts for buildings using walk-in coolers and freezers would not be feasible due to uncertainties in the interaction between the building space and the walk-in systems for any integrated model. (Manitowoc, Public Meeting Transcript, No. 15 at p. 187) AHRI stated that for commercial refrigeration equipment standards rulemaking analysis, DOE used a whole-building simulation approach and found that the interaction between the commercial refrigeration equipment and the building HVAC system was minimal. (Public Meeting Transcript, No. 15 at p. 188) ACEEE also suggested that DOE should not pursue this approach due to the considerable additional complexities involved. (Public Meeting Transcript, No. 15 at p. 189) After considering the complexities further and in light of the aforementioned comments, DOE has decided not to use the whole-building simulation approach for determining impacts on the energy use of buildings using the WICF equipment.

Manitowoc commented on the approach to sizing of the refrigeration system and pointed out that the refrigeration systems may be conservatively sized when compared to the load, so DOE should not assume the refrigeration system runs 90 percent of the time. The sizing may also depend on application (a convenience store vs. a restaurant). (Public Meeting Transcript, No. 15 at p. 194) For the preliminary analysis, DOE used a sizing methodology that conforms to the approach outlined in the proposed test procedure. The key premise of this sizing algorithm is that for walk in refrigeration systems, the ratio of the refrigeration load (averaged over an 8-hour peak load period) to the nominal capacity of the refrigeration system should be 70 percent for coolers and 80 percent for freezers. This capacity would be adequate to meet typical walk-in refrigeration loads seen over a 24-hour daily use cycle.

2.7 LIFE-CYCLE COST AND PAYBACK PERIOD ANALYSES

The effect of amended standards on individual customers usually includes a reduction in operating cost and an increase in purchase cost, which together determine the economic impact of standards on individual customers. This chapter describes the following two metrics, which DOE used in the analysis to measure this impact:

Life-cycle cost (LCC) is the total customer cost of an appliance or equipment, generally over the life of the appliance or equipment, including purchase and operating costs. The latter consist of maintenance, repair, and energy costs. Future operating costs are discounted to the time of purchase and summed over the lifetime of the appliance or equipment.

Payback period (PBP) measures the amount of time it takes customers to recover the assumed higher purchase price of a more energy-efficient equipment through reduced operating costs.

New or amended energy conservation standards typically affect equipment-operating expenses and purchase prices. DOE evaluated the net LCC to analyze the net effect of amended walk-in cooler and freezer standards on customers. DOE used the cost-efficiency relationship derived from the engineering analysis, along with the energy costs derived from the energy use characterization. Inputs to the LCC calculation include the installed customer cost of the equipment (customer purchase price plus installation cost), operating expenses (energy, repair, and maintenance costs), the lifetime of the unit, and a discount rate.

Because the installed cost of the equipment typically increases while operating cost typically decreases in response to amended standards, there is a point in the life of the equipment with higher-than-baseline efficiency when the net reduction in operating costs (in dollars) since the time of purchase is equal to the increase in the purchase price of the higher efficiency equipment. The length of time required for equipment to reach this cost-equivalence point is known as the PBP.

DOE conducted the LCC and PBP analyses using typical values to reflect energy consumption in the field. DOE identified several input values for estimating the LCC, including retail prices; electricity prices; discount rate; maintenance, repair, and installation costs; and equipment lifetimes.

DOE developed discount rates from estimates of the interest rate (finance cost) applied to commercial equipment purchases. Following accepted principles of financial theory, the finance cost of raising funds to purchase such equipment can be interpreted as either (1) the financial cost of any debt incurred to purchase the equipment (interest charges on debt), or (2) the opportunity cost of any equity used to purchase the equipment (interest earnings on household or business equity).

The LCC and PBP model was developed using Microsoft Excel spreadsheets combined with Crystal Ball, a commercially available add-in. The LCC and PBP analyses explicitly model the uncertainty and variability in the model's inputs using Monte Carlo simulation and probability distributions.

The LCC analysis estimated energy use for each walk-in cooler or freezer as described in chapter 7 of the preliminary TSD. Aside from energy use, other important factors influencing the analyses include energy prices, installation costs, equipment distribution markups, and sales tax. At the national and regional levels, the LCC spreadsheets explicitly model the uncertainty and variability in the model's inputs using probability distributions based on the shipment of equipment to different regions of the country. The majority of WICF units have outdoor condensers, and the energy use of walk-in coolers and freezers is sensitive to the climate when the condensing units are located outdoors. Consequently, the LCC and PBP analyses need to take into account where the nation's walk-in coolers and freezers are located. These analyses apply a probability distribution to apportion the shares of total number of walk-in coolers and freezers over different states according to their population and estimate the annual energy consumption based on a population-weighted representative climate profile for the state.

As mentioned, DOE generated LCC and PBP results as probability distributions using a simulation based on Monte Carlo analysis methods in which certain key inputs consist of probability distributions rather than single-point values. Therefore, the outcomes can be expressed as probability distributions. As a result, the Monte Carlo analysis produces a range of LCC and PBP results. A distinct advantage of this type of approach is that DOE can identify the percentage of customers achieving LCC savings or attaining certain PBP values, in addition to identifying the average LCC savings or average PBP for a particular efficiency level.

DOE received a number of comments from stakeholders on the LCC and PBP analysis methods and proposed sources of data.

2.7.1 General Approach for Life-Cycle Cost and Payback Period Analyses

During the framework public meeting, DOE sought comments from interested parties on the general approach for the LCC and PBP analyses. AHRI commented that transportation costs should be accounted for in DOE's analysis. (AHRI, No. 15 at p. 200) AHRI further stated that installation costs might be correlated with the WICF unit size.

Based on the above two comments from AHRI, DOE has decided to include the transportation costs in the life-cycle cost analysis and also determine the installation costs of the WICF units correlated with the unit sizes.

2.7.2 Electricity Prices

Electricity price information is required to calculate the dollar benefits to customers who purchase and operate more efficient walk-in coolers and freezers. The electricity cost savings comprise the benefit side of the cost-benefit analysis used to estimate the LCC impacts of more efficient walk-ins. To value the electricity cost savings, DOE proposed to use the latest available edition of EIA's Annual Energy Outlook for each region of the country. AHRI concurred with the DOE approach in its comment. (AHRI, No. 33 at p. 6)

2.7.3 Repair Costs

The repair cost is the cost to the customer of replacing or repairing WICF components that have failed. Because data were not available to indicate how repair costs vary with equipment efficiency, DOE proposed to use one of the following two scenarios: (1) repair costs that varied in direct proportion with the manufacturer price of the equipment, or (2) repair costs that did not increase with efficiency. AHRI commented that as equipment become more efficient, their repair costs increase. (AHRI, No. 15 at p. 200) HARDI also commented that if a performance standard is an all-encompassing energy consumption figure, labor costs could increase for equipment that is more efficient. (HARDI, No. 15 at p. 207)

With respect to the WICF equipment, in particular, DOE finds that repair costs for the envelope is essentially zero because envelopes are typically replaced instead of repaired. However, the repair costs for the refrigeration system can either increase or decrease with respect to more efficient technology. In this case, DOE will assume that the repair cost for the refrigeration system will increase with increased efficiency of the refrigeration system. Additionally, DOE is always interested in obtaining the most recent and accurate labor costs possible; DOE invites further data or comment on both of these subjects.

HARDI voiced concern regarding the lack of data for maintenance costs for new technologies. (HARDI, No. 28 at p. 2) Hired Hand specified one technology, automated doors, which have lower maintenance costs than traditional doors. (Hired Hand, No. 27 at p. 3)

DOE will assume that maintenance cost for the WICF equipment remains constant even as the equipment efficiency increases.

DOE received several comments suggesting that standards that require new technologies would lead to "learning curve" related maintenance costs. (Manitowoc, No. 15 at p. 203; HARDI, No. 15 at p. 212; AHRI, No. 33 at p. 6) DOE also received comments regarding the change in potential "learning curve" related costs over time. (SCE, No. 15 at p. 208; Earthjustice, No. 15 at p. 209; Eliason, No. 19 on 8-4,5,6 at p.1)

All the improved technologies being proposed by DOE for the refrigeration system (e.g., scroll compressors, high efficiency fans, motors, coils, etc.) are existing and commercially available in the refrigeration and/or HVAC products market. WICF equipment is usually maintained by contractors who specialize in maintenance of both refrigeration and HVAC products. Consequently, DOE did not consider any "learning curve" related maintenance cost for the refrigeration system. For the improved technologies being proposed by DOE for the envelope (e.g., higher insulation thickness, door and sealant enhancement, active and passive infiltration reduction devices, high efficacy lighting, etc.), DOE did not find any consensus of opinion regarding “learning curve” related maintenance cost. DOE requests comment on this issue.

2.7.4 Equipment Lifetime

DOE defined equipment lifetime as the age when the walk-in cooler or freezer unit is retired from service. DOE received multiple comments regarding equipment lifetime. Manitowoc commented that DOE’s estimates of equipment lifetime are reasonable. (Manitowoc, No. 15 at p. 204) Additionally, Craig Industries stated that a 10-year lifetime for a refrigeration system is rather high. (Craig, No. 15 at p. 205) AHRI stated that refrigeration system lifetime is between 8 and 12 years and envelope lifetime is between 12 and 25 years. (AHRI, No. 33 at p. 7)

DOE will develop and use a Weibull distribution (a separate one for the envelope and the refrigeration system) for equipment lifetimes that accounts for all of this input.

DOE received multiple comments regarding the salvage value of the equipment after its useful life. Owens Corning and Craig Industries asked DOE to consider the recyclability of the envelope, including the insulation material. (Owens Corning, No. 31 at p. 2; Craig, No. 22 at p. 7) Craig Industries also asked DOE to consider certain disposal costs. (Craig, No. 8 at p. 1)

DOE’s analysis will consider both salvage values and disposal costs at end of life of the total envelope and the insulation in the panels.

2.8 NATIONAL IMPACT ANALYSIS

The NIA assesses the national energy savings (NES) and the NPV from a national perspective of total customer costs and savings expected to result from standards at specific efficiency levels. DOE determined both the NPV and NES for the performance levels considered for the equipment classes analyzed. To make the analysis more accessible and transparent to all interested parties, DOE prepared a Microsoft Excel spreadsheet model to forecast NES and the national customer economic costs and savings resulting from new standards. The spreadsheet model uses typical values (as opposed to probability distributions) as inputs. To assess the effect of input uncertainty on NES and NPV results, DOE has developed its spreadsheet model to conduct sensitivity analyses by running scenarios on specific input variables.

2.8.1 Net Present Value Analysis

The inputs for determining net present value (NPV) are: (1) total annual installed cost; (2) total annual savings in operating costs; (3) a discount factor; (4) present value of costs; and (5) present value of savings. DOE calculated net savings each year as the difference between the base case and each standards case in total savings in operating costs and total increases in installed costs. DOE calculated savings over the life of each product, accounting for differences in annual energy rates. DOE calculated NPV as the difference between the present value of operating cost savings and the present value of total installed costs. DOE used a discount factor based on real discount rates of 3 and 7 percent to discount future costs and savings to present values.

Several comments were received suggesting DOE use a real discount rate of 2 to 3 percent for its national impact analysis. (Joint Comment, No. 21 at p. 3; NEEA, No. 18 at p. 4) Additionally DOE received comment that convenience stores and floral applications be given consideration when estimating discount rates. (ICS, No. 15 at p. 199) A joint comment was also submitted suggesting that DOE should not apply discount rates to non-monetary indicators, such as tons of emissions or quads of energy. (Joint Comment, No. 21 at p. 4)

As directed by the Office of Management and Budget, DOE will continue to use both 3 and 7-percent real discount rates for its NPV analysis and will continue to discount non-monetary indicators, such as physical units of measure.

DOE calculated increases in total installed costs as the difference in total installed cost between the base case and standards case (*i.e.*, once the standards take effect). Because the more efficient equipment purchased in the standards case usually costs more than equipment bought in the base case, cost increases appear as negative values in the NPV.

DOE expressed savings in operating costs as decreases associated with the lower energy consumption of equipment purchased in the standards case compared to the base efficiency case. Total savings in operating costs are the product of savings per unit and the number of units of each vintage that survive in a given year.

Chapter 10 of the preliminary TSD provides additional details on the national impacts analysis.

2.9 PRELIMINARY MANUFACTURER IMPACT ANALYSIS

DOE performed a preliminary manufacturer impact analysis (MIA) to estimate the financial impact of higher energy conservation standards on walk-in cooler and freezer manufacturers, and to calculate the impact of such standards on employment and manufacturing capacity. The MIA has both quantitative and qualitative aspects. The quantitative part of the MIA relies on the government regulatory impact model (GRIM), an industry-cash-flow model customized for these three industries. The GRIM inputs are information on the industry cost structure, shipments, and revenues. This includes information from many of the analyses described above, such as manufacturing costs and prices from the engineering analysis and shipments forecasts. The key GRIM output is the industry net present value (INPV). Different sets of assumptions (scenarios) will produce different results. The qualitative part of the MIA addresses factors such as equipment characteristics, characteristics of particular firms, and market and equipment trends, and includes assessment of the impacts of standards on manufacturer subgroups. Chapter 12 of the preliminary TSD describes the complete preliminary MIA.

DOE conducts each MIA in three phases and will further tailor the analytical framework for each MIA based on comments from interested parties. In Phase I, DOE creates an industry profile to characterize the industry and identify important issues that require consideration. In Phase II, DOE prepares an industry cash-flow model and interview questionnaire to guide subsequent discussions. In Phase III, DOE interviews manufacturers and assesses the impacts of standards quantitatively and qualitatively. DOE assesses industry and subgroup cash flow and NPV using the GRIM. DOE then assesses impacts on competition, manufacturing capacity, employment, and regulatory burden based on manufacturer interview feedback and discussions.

Until recently, DOE reported MIA results in its standards rulemakings only during the NOPR phase of the rulemaking. However, DOE is now evaluating and reporting preliminary MIA information in this preliminary analysis. DOE gathered this information during the preliminary manufacturer interviews conducted for the engineering analysis. See chapter 12 of the preliminary TSD for a summary of manufacturers' concerns regarding the impacts of new energy conservation standards for this rulemaking.

As part of the NOPR, DOE will seek comments from manufacturers about their potential loss of market share, changes in the efficiency distribution within each industry, and the total reduction in equipment shipments at each new energy conservation standard level. DOE will then estimate the impacts on the industry quantitatively and qualitatively. DOE seeks further comment from interested parties about the impact of new standards on domestic manufacturers.

The following is an overview of the information DOE will collect and the analysis it will conduct during the preliminary MIA (chapter 12 of the preliminary TSD).

2.9.1 Industry Cash-Flow Analysis

The industry cash-flow analysis relies primarily on the GRIM. DOE uses the GRIM to analyze the financial impacts of more stringent energy conservation standards on the industry that produces the equipment covered by the standard. The GRIM analysis uses many factors to determine annual cash flows from a new standard: annual expected revenues; manufacturer costs, including cost of goods sold, depreciation, research and development, selling, general, and administrative expenses; taxes; and conversion capital expenditures. DOE compares the results against base-case projections that involve no new standards. The financial impact of new standards is then the difference between the two sets of discounted annual cash flows. Other performance metrics such as return on invested capital are available from the GRIM. For more information on the industry cash-flow analysis, refer to chapter 12 of the preliminary TSD.

2.9.2 Manufacturer Subgroup Analysis

Industry cost estimates are not adequate to assess differential impacts among subgroups of manufacturers. For example, small and niche manufacturers, or manufacturers whose cost structure differs significantly from the industry average, could be more negatively affected by the imposition of standards. Ideally, DOE would consider the impact on every firm individually; however, since this usually is not possible, DOE typically uses the results of the industry characterization to group manufacturers exhibiting similar characteristics.

DOE outlined the process it uses to establish manufacturer subgroups in the framework document and sought comment from interested parties on any potential subgroups within the industry.

During the manufacturer interview process conducted as part of the NOPR, DOE will discuss the potential subgroups and subgroup members it has identified for the analysis. DOE will encourage manufacturers to recommend subgroups or characteristics appropriate for the subgroup analysis. DOE will also attempt to contact component suppliers, dealers, distributors, and contractors during the manufacturer interview process conducted for the NOPR. For more detail on the manufacturer subgroup analysis, see chapter 12 of the preliminary TSD.

2.9.3 Competitive Impacts Assessment

DOE must consider whether a new standard is likely to reduce industry competition, and the Attorney General must determine the impacts, if any, of reduced competition. DOE will make a determined effort to gather and report firm-specific financial information and impacts. The competitive impacts assessment will focus on assessing the impacts on smaller manufacturers. DOE will base this assessment on manufacturing cost data and information collected from interviews with manufacturers. The interviews will focus on gathering information to help assess asymmetrical cost increases to some manufacturers, increased proportion of fixed costs potentially increasing business risks, and potential barriers to market entry (*e.g.*, proprietary technologies). The NOPR will be submitted to the Attorney General for a review of the impacts of standards on competition. The Attorney General's comments on the proposed rule will be considered in preparing the final rule.

2.9.4 Cumulative Regulatory Burden

DOE recognizes and seeks to mitigate the overlapping effects on manufacturers of new or revised DOE standards and other regulatory actions affecting the same equipment. DOE will analyze and consider the impact on manufacturers of multiple, product-specific regulatory actions. DOE outlined the cumulative regulatory burden process in the framework document and sought comment on any additional regulations facing the walk-in cooler and freezer industry. Regulations that may affect WICF manufacturers include the phase-out of chlorofluorocarbons (CFCs) and HCFCs as refrigerants, costs of testing for fire and safety criteria, NSF International certification requirements, and international, state, and local building codes. See Chapter 13 of the preliminary TSD for further discussion of this issue.

2.9.5 Preliminary Results for the Manufacturer Impact Analysis

As part of the preliminary MIA, DOE discussed potential impacts of new energy conservation standards with manufacturers responsible for a majority of walk-in cooler and freezer equipment sales. These discussions occurred during the interviews DOE conducted for the engineering analysis. The interviews provided valuable information that DOE used to evaluate the impacts of new energy conservation standards on manufacturers' cash flows, manufacturing capacities, and employment levels. DOE discusses its findings from the preliminary MIA interviews in the executive summary and in chapter 13 of the preliminary TSD.

2.10 LIFE-CYCLE COST SUBGROUP ANALYSIS

The LCC subgroup analysis evaluates economic impacts on selected customer sub-groups who might be adversely affected by a change in the national energy conservation standards for the considered equipment. DOE evaluates impacts on particular subgroups of customers in part by analyzing the LCC impacts and PBP for those particular customers.

DOE will use the LCC spreadsheet model to evaluate impacts on customer subgroups. DOE can analyze the LCC for any subgroup by applying the LCC spreadsheet model to only that subgroup. DOE is particularly sensitive to increases in the customer price of the considered equipment, wishing to avoid a negative economic impact on any identified customer subgroup.

DOE received several comments regarding potential customer subgroups. While Eliason suggested independent grocery stores, convenience stores and cafeterias as possible subgroups, ICS stated that DOE should consider small independent restaurants as a possible subgroup as well. (Eliason, No. 19 on 11-1, at p.1; ICS, Public Meeting Transcript, No. 15 at p. 222) Manitowoc stated that food service, convenience stores, and grocery stores should be considered in this part of its analysis. (Manitowoc, Public Meeting Transcript, No. 15 at p. 231)

DOE will review the available information with respect to the identified customer subgroups and consider independent grocery stores and small convenience stores in its LCC subgroup analysis.

2.11 UTILITY IMPACT ANALYSIS

The utility impact analysis includes an analysis of the effect of new energy conservation standards on the electric and the gas utility industries. For this analysis, DOE adapted National Energy Modeling System (NEMS), a large multi-sectoral, partial-equilibrium model of the U.S. energy sector that the EIA developed throughout the past decade primarily for preparing EIA's AEO. In previous rulemakings, a variant of NEMS (currently termed NEMS-BT, BT referring to DOE's Building Technologies program) was developed to address the specific impacts of an energy conservation standard.

Available in the public domain, NEMS produces a widely recognized baseline energy forecast for the United States through 2030. The typical NEMS outputs include forecasts of electricity sales, prices, and electric generating capacity. DOE conducts the utility impact analysis as a scenario that departs from the latest AEO reference case. In other words, the energy savings impacts from amended energy conservation standards are modeled using NEMS-BT to generate forecasts that deviate from the AEO reference case.

2.12 ENVIRONMENTAL ASSESSMENT

The intent of the environmental assessment is to quantify and consider the environmental effects of amended energy conservation standards for walk-in equipment. The primary environmental effects of these standards would be reduced power plant emissions resulting from reduced consumption of electricity. DOE will assess these environmental effects by using NEMS-BT to provide key inputs to its analysis. The portion of the environmental assessment that will be produced by NEMS-BT considers carbon dioxide (CO_2), nitrogen oxides (NO_X), and mercury (Hg). The environmental assessment also considers impacts on SO_2 emissions. After a brief discussion of general methodology, this section will address each of the relevant emissions. This section then explains how DOE plans to monetize the benefits associated with emissions reductions.

2.12.1 Carbon Dioxide

In the absence of any Federal emissions control regulation of power plant emissions of CO_2, a DOE standard is likely to result in reductions of these emissions. The CO_2 emission reductions likely to result from a standard will be estimated using NEMS-BT and national energy savings estimates drawn from the NIA spreadsheet model. The net benefit of the standard is the difference between emissions estimated by NEMS-BT at each standard level considered and the *AEO* Reference Case. NEMS-BT tracks CO_2 emissions using a detailed module that provides results with broad coverage of all sectors and inclusion of interactive effects.

2.12.2 Sulfur Dioxide

DOE has preliminarily determined that SO_2 emissions from affected Electric Generating Units (EGUs) are subject to nationwide and regional emissions cap and trading programs that are likely to eliminate the standards' impact on SO_2 emissions. The costs of meeting such emission cap requirements are reflected in the electricity prices and forecasts used in DOE's analysis of the standards. Title IV of the Clean Air Act sets an annual emissions cap on SO_2 for all affected EGUs. SO_2 emissions from 28 eastern States and the District of Columbia (DC) are also limited under the Clean Air Interstate Rule (CAIR, published in the *Federal Register* on May 12, 2005. 70 FR 25162 (May 12, 2005)), which creates an allowance-based trading program that will gradually replace the Title IV program in those States and DC. (The recent legal history surrounding CAIR is discussed below.) The attainment of the emissions caps is flexible among EGUs and is enforced through the use of emissions allowances and tradable permits. Under existing EPA regulations, any excess SO_2 emission allowances resulting from the lower electricity demand caused by the imposition of an efficiency standard could be used to permit offsetting increases in SO_2 emissions by any regulated EGU. However, if the standard resulted in a permanent increase in the quantity of unused emission allowances, there would be an overall reduction in SO_2 emissions from the standards. While there remains some uncertainty about the ultimate effects of efficiency standards on SO_2 emissions covered by the existing cap and trade system, the NEMS-BT modeling system that DOE plans to use to forecast emissions reductions currently indicates that no physical reductions in power sector emissions would occur for $SO_{2.}$

Even if there is no significant reduction in the overall emissions of SO_2 that results from the standard, there may still be some economic benefit from reduced demand for SO_2 emission allowances that is not fully reflected in the cost savings experienced by individual consumers. Electricity savings that decrease the overall demand for SO_2 emissions allowances could lower allowance prices and thereby result in some economic benefits for all electricity consumers, not just those that reduced their electricity use as a result of an efficiency standard. DOE does not plan to monetize this particular benefit because the effect on the SO_2 allowance price from any single energy conservation standard is likely to be small and highly uncertain.

2.12.3 Nitrogen Oxides

NEMS-BT also has an algorithm for estimating NO_X emissions from power generation. The impact of these emissions, however, will be affected by the CAIR, which the Environmental Protection Agency (EPA) issued on May 12, 2005. CAIR will permanently cap emissions of NO_X in 28 eastern states and the District of Columbia. 70 FR 25162 (May 12, 2005).

Much like SO_2 emissions, a cap on NO_X emissions means that the amended walk-ins standards may have little or no physical effect on these emissions in the 28 eastern States and the DC covered by CAIR. Although CAIR has been remanded to the EPA by the DC Circuit, it will remain in effect until it is replaced by a rule consistent with the Court's July 11, 2008, opinion in North Carolina v. EPA. 531 F.3d 896 (DC Cir. 2008); see also North Carolina v. EPA, 550 F.3d 1176 (DC Cir. 2008). Because all States covered by CAIR opted to reduce NO_X emissions through participation in cap-and-trade programs for electric generating units, emissions from these sources are capped across the CAIR region.

Standards may produce an environmental-related economic benefit in the form of lower prices for emissions allowance credits. As with SO_2 allowance prices, DOE does not plan to monetize this particular benefit because the effect on the NO_X allowance price from any single energy conservation standard is likely small and highly uncertain.

Accordingly, DOE plans to use NEMS-BT to estimate the emissions reductions from possible standards in the 22 States where emissions are not capped.

2.12.4 Mercury

Similar to emissions of SO_2 and NO_X, future emissions of Hg would have been subject to emissions caps. In May 2005, EPA issued the Clean Air Mercury Rule (CAMR). 70 FR 28606 (May 18, 2005). CAMR would have permanently capped emissions of mercury for new and existing coal-fired power plants in all States by 2010. However, on February 8, 2008, the DC Circuit issued its decision in New Jersey v. Environmental Protection Agency, in which the DC Circuit, among other actions, vacated the CAMR. 517 F.3d 574 (DC Cir. 2008). EPA has decided to develop emissions standards for power plants under the Clean Air Act (Section 112), consistent with the DC Circuit's opinion on the CAMR. See http://www.epa.gov/air/mercuryrule/pdfs/certpetition_withdrawal.pdf. Pending EPA's forthcoming revisions to the rule, DOE is excluding the CAMR from its Environmental Analysis. In the absence of CAMR, a DOE standard would likely reduce Hg emissions and DOE plans to use NEMS-BT to estimate these emission reductions.

2.12.5 Particulate Matter

Earthjustice stated that DOE's characterization of the PM formation as "complex" does not remove the need for DOE to considering the impact of reductions in PM in standards rulemakings. (Earthjustice, No. 24 at p. 4)

DOE acknowledges that particulate matter (PM) impacts are of concern due to human exposures that can impact health. However, impacts of PM emissions reduction are much more difficult to estimate than other emissions reductions due to the complex interactions between PM, other power plant emissions, meteorology, and atmospheric chemistry that impact human exposure to particulates. Human exposure to PM usually occurs at a significant distance from the power plants that are emitting particulates and particulate precursors. When power plant emissions travel this distance, they undergo highly complex atmospheric chemical reactions. Although the EPA does keep inventories of direct PM emissions of power plants, in its source attribution reviews, the EPA does not separate direct PM emissions from power plants from the sulfate particulates indirectly produced through complex atmospheric chemical reactions. The great majority of PM emissions from power plants are of these secondary particles (secondary sulfates). Thus, it is not useful to examine how the amended standard impacts direct PM emissions independent of indirect PM production and atmospheric dynamics. Therefore, DOE is not planning to assess the impact of these standards on particulate emissions. Further, even the cumulative impact of PM emissions from power plants and indirect emissions of pollutants from other sources is unlikely to be significant.

2.12.6 Monetization of Emissions Reduction Benefits

DOE received a number of comments on the monetization of pollutants. SCE noted the example of monetized pollutants in the Time-Dependent Valuation approach available on the California Energy Commission's website. (SCE, Public Meeting Transcript, No. 15 at p. 240) The Joint Comment proposed that DOE monetize CO_2 emissions as equal in value to their prices under the proposed Climate Security Act as modeled in EIA's 2008 analysis of the same. (Joint Comment, No. 21 at p. 3) Earthjustice stated that DOE must quantify the effect of a CO_2 emissions cap on energy prices in the lifecycle cost analysis, and account in the NPV for the effect of the standard in reducing allowance prices. (Earthjustice, No. 24 at p. 3) By contrast, EEI argued that any environmental regulation that internalized the cost of emissions would account for that cost in the price of electricity, so adding these costs would amount to "double counting," which could distort the life cycle cost analysis. (EEI, No. 25 at p. 4) AHRI stated that DOE should not estimate a price for CO_2 emissions because there is currently no consensus on any single estimate of the value of CO_2 emissions and the US has not set an emissions cap; therefore, DOE should not indulge in speculation to determine a value when it has no statutory obligation to do so. Moreover, DOE should not allow evaluation of environmental impacts to negate or moot what has always been, and should remain, the core analysis in appliance standards rulemakings, *i.e.* consumer payback and life cycle cost analysis. If DOE decides to estimate the monetary value of the CO_2 emission reductions, it should incorporate increased CO_2 emissions from the manufacture of higher efficiency units. (AHRI, No.33 at p. 8) DOE is considering the appropriate estimate(s) for the value of avoided CO_2 emissions resulting from revised standards.

For those emissions for which real national emission reductions are anticipated (CO_2, Hg, and NO_X for 22 states), only ranges of estimated economic values based on environmental damage studies of varying quality and applicability are available. Therefore, DOE plans to report estimates of monetary benefits derived using these values and plans to consider these benefits in weighing the costs and benefits of each of the standard levels considered. To calculate a present value of the stream of monetary values, DOE will discount the values in each of the four cases using the discount rates that had been used to obtain the SCC values in each case.

In order to estimate the monetary value of benefits resulting from reduced emissions of CO_2 emissions, it is DOE's intent to use in its analysis the most current Social Cost of Carbon (SCC) values developed and/or agreed to by interagency reviews. The SCC is intended to be a monetary measure of the incremental damage resulting from greenhouse gas (GHG) emissions, including, but not limited to, net agricultural productivity loss, human health effects, property damage from sea level rise, and changes in ecosystem services. Any effort to quantify and to monetize the harms associated with climate change will raise serious questions of science, economics, and ethics; but with full regard for the limits of both quantification and monetization, the SCC can be used to provide estimates of the social benefits of reductions in GHG emissions.

At the time of this notice, the most recent interagency estimates of the potential global benefits resulting from reduced CO_2 emissions in 2010 are $4.7, $21.4, $35.1, and $64.9 per metric ton in 2007 dollars. These values are then adjusted to 2009$ using the standard GDP deflator value for 2008 and 2009. For emissions (or emission reductions) that occur in later years, these values grow in real terms over time. Additionally, the interagency group determined that a range of values from 7 percent to 23 percent should be used to adjust the global SCC to calculate domestic effects, although preference will be given to consideration of the global benefits of reducing CO_2 emissions. See appendix A of the Annex to chapter 15 of the preliminary Technical Support Document for the full range of annual SCC estimates from 2010 to 2050.

DOE recognizes that scientific and economic knowledge continues to evolve rapidly as to the contribution of CO_2 and other GHG to changes in the future global climate and the potential resulting damages to the world economy. Thus, these values are subject to change.

DOE also intends to estimate the potential monetary benefit of reduced NO_X and Hg emissions resulting from the standard levels it considers. For NO_X emissions, available estimates suggest a very wide range of monetary values for NO_X emissions, ranging from $370 per ton to $3,800 per ton of NO_X from stationary sources, measured in 2001$ (equivalent to a range of $447 to $4,591 per ton in 2009$). Refer to the OMB, Office of Information and Regulatory Affairs, "2006 Report to Congress on the Costs and Benefits of Federal Regulations and Unfunded Mandates on State, Local, and Tribal Entities," for additional information.

For Hg emissions reductions, DOE has previously determined that the impact of mercury emissions from power plants on humans is considered highly uncertain. However, DOE identified two estimates of the environmental damage of mercury based on two estimates of the adverse impact of childhood exposure to methyl mercury on intelligence quotient (IQ) for American children, and subsequent loss of lifetime economic productivity resulting from these IQ losses. The high-end estimate is based on an estimate of the current aggregate cost of the loss of IQ in American children that results from exposure to mercury of U.S. power plant origin ($1.3 billion per year in year 2000$), which works out to $33.7 million per ton emitted per year in 2009$). Refer to L. Trasande *et al*., "Applying Cost Analyses to Drive Policy that Protects

Children," 1076 Ann. N.Y. Acad. Sci. 911 (2006) for additional information. The low-end estimate is $0.66 million per ton emitted (in 2004$) or $0.745 million per ton in 2009$. DOE derived this estimate from a published evaluation of mercury control using different methods and assumptions from the first study but also based on the present value of the lifetime earnings of children exposed to mercury. See Ted Gayer and Robert Hahn, "Designing Environmental Policy: Lessons from the Regulation of Mercury Emissions," Regulatory Analysis 05–01, American Enterprise Institute-Brookings Joint Center for Regulatory Studies, Washington, DC (2004). A version of this paper was published in the Journal of Regulatory Economics in 2006. The estimate was derived by back-calculating the annual benefits per ton from the net present value of benefits reported in the study.

For both NO_X and Hg, DOE will conduct two calculations of the monetary benefits derived using each of the economic values used, one using a real discount rate of 3 percent and another using a real discount rate of 7 percent, in accordance with the U.S. Office of Management and Budget (OMB) guidance. (OMB, Circular A-4: Regulatory Analysis (Sept. 17, 2003). EEI stated that DOE should account for the rise in renewable portfolio standards as well as the continuous fall in NO_X, CO_2 and SO_2 emissions. (EEI, No. 25 at p. 4) As stated above, DOE utilizes the most recent forecasts from EIA's NEMS to estimate the future mix of power generation sources. EIA accounts for policies that have been enacted at the time of its analysis, including renewable portfolio standards, and DOE believes that this approach provides the most reliable basis for estimating future power sector emissions.

For more detail on the environmental assessment, refer to the environmental assessment report in the preliminary TSD.

2.13 EMPLOYMENT IMPACT ANALYSIS

The imposition of standards can affect employment both directly and indirectly. Direct employment impacts are changes in the number of employees at plants that produce the covered equipment and at the affiliated distribution and service companies. DOE evaluated direct employment impacts in the manufacturer impact analysis. Indirect employment impacts may result from customers shifting expenditures between goods (the substitution effect) and from changes in income and overall expenditure levels (the income effect). DOE will use PNNL's impact of sector energy technologies (ImSET) model to investigate the combined direct and indirect employment impacts. The ImSET model, which was developed for DOE's Office of Planning, Budget, and Analysis, estimates the employment and income effects energy-saving technologies produce in buildings, industry, and transportation. Compared with simple economic multiplier approaches, ImSET allows for more complete and automated analysis of the economic impacts of energy conservation investments.

2.14 REGULATORY IMPACT ANALYSIS

In the NOPR, DOE will prepare a regulatory impact analysis (RIA) pursuant to Executive Order 12866, Regulatory Planning and Review, 58 FR 51735, October 4, 1993. The RIA is subject to review under the Executive Order by the Office of Information and Regulatory Affairs at the Office of Management and Budget. The RIA addresses the potential for non-regulatory approaches to supplant or augment energy conservation standards in order to improve the energy efficiency or reduce the energy consumption of the equipment covered under this rulemaking.

DOE recognizes that non-regulatory efforts by manufacturers, utilities, and other interested parties can substantially improve energy efficiency or reduce energy consumption. DOE will base its assessment on the actual impacts of any such initiatives to date, but also will consider information presented by interested parties on the impacts existing initiatives might have in the future.